

STAT

The Atlantic Ocean's Influence on  
the Freezing and Thawing of Rivers

G. P. Brogan.

Trudy Gosudarstvennogo Gidrologicheskogo Instituta  
/Works of the State Hydrological Institute 7,  
No 10, pp 174-205; 95-135.

Leningrad: 1940.

STAT

"The Atlantic Ocean's Influence  
on the Freezing and Thawing of Rivers"

G. P. BREGMAN

[Note: The following is an abstract of a report that appeared in the organ 'Trudy Gosudarstvennogo Gidrologicheskogo Instituta' (Works of the State Hydrological Institute), No 10 (1940), pages 174-205; Leningrad.]

Beginning our discussions with a short description of the development of ice processes on the rivers in the European part of the USSR and following the principal facts explaining these processes, we come to the Atlantic Ocean, from which we return by inverse reasoning to the rivers. The cycle ends, and it is possible to note the most important supported conclusions which logically result from the whole matter. Certain of them are generally known, but still it is unnecessary to exclude them here.

1. The general basis of the development of ice processes on the rivers of the European part of USSR is explained mostly through meteorological considerations. The local deviations from this general basis occur because of peculiarities of the rivers' hydrological regime (depth of water, temperature of stream, turbulent mixing, morphological peculiarities, etc).

2. It is possible to find in the meteorological processes at the beginning of autumn and just before winter (for freezing) and at the end of winter and beginning of spring (for thawing and opening of rivers) the characteristic effects of meteorological conditions.

3. Meteorological conditions governing the European part of the USSR also are under the strong influences of warm air-currents, occurring as a result of energy exchange between ocean and atmosphere and between ocean

and continent. This certainly does not exclude the influences of North-Eastern intrusions from the region of the Siberian anticyclone. In periods preceding the freezing and thawing of rivers these intrusions certainly have to be considered, as in certain cases they can stop the mechanism governing the Atlantic influences. This factor probably does not present particular difficulties, for instance, with the aid of typification of atmospheric circulation.

4. Warm air-currents of Atlantic origin, that is currents which obtain the greatest amount of heat from Atlantic water, are the most important for the greatest part of the European territory of the USSR.

5. In connection with the fact that forecasts of thawing and freezing of rivers, same as all hydrological forecasts, reflect the variability of phenomena and their mean state and can serve only as a measure of comparison, it is necessary, therefore, to study the most variable components making up the regime of the Atlantic waters. Components with small absolute values of variability cannot be recognized in this particular case as decisive ones.

6. The changing transfer of heat on the Atlantic's surface layers, which is caused by wind blowing at the ocean's surface, is the most powerful and variable component making up the regime of the Atlantic waters.

7. The plan of the procedure permits one to determine the relative amount of heat transferred by the layer of the drifting current to the air current, which heat moves across the Atlantic and is then transferred

into the European part of the USSR. The relative values of the warm "Changes" picked up by the air currents could be calculated sufficiently in advance of the time of the beginning of the corresponding ice phase. In order to be exact in the final results it is necessary to make an attempt at calculating the weakening of the air currents' energy supply during its movements into the interior of the continent.

8. The meteorological-synoptic analysis can be put on a more stable physical basis because of the fact that there is a possibility of obtaining the characteristic variations in the relative amounts of heat in the air currents of the Atlantic origin with different types of synoptical processes.

Compilation of maps showing the ice phases of rivers in the European part of USSR will allow greater accuracy, than at present, in relating synoptical analysis to the development of ice processes on rivers. For the same reason, another possibility is hydro-synoptical analysis of ice phases, which cause local deviations from the general basis of development of ice processes on rivers.

The relative numerical characteristics governing the heat obtained by air currents from the ocean's surface, together with meteorological and hydrological analysis, creates objectively satisfactory data for developing a basic method of forecasting ice phases on the rivers of the European part of the USSR. A forecasting procedure can be derived, therefore, by calculating that part of the relative heat returned by the ocean to the atmosphere and by drawing hydrometeorological analogies (typification of

processes) in the second part of the problem.

The same data could be utilized to establish the local dependences for the forecasts of ice phases at individual stations on individual rivers. One form of such relations could be the dependence (graphical or analytical) of date of beginning ice phase upon heat transfer for various types of synoptical processes.

Basic and local (for individual stations) forecasts certainly do not exclude one another, and in further investigations the State Hydrological Institute decided to proceed along both lines of study in parallel manner. The observations states do not reject the possibility of correlation analysis as a possible method for obtaining stochastic dependences. These dependences between relative return of heat by ocean to atmosphere (with determination of the character of atmospheric circulation) and beginning of thawing or freezing of rivers in the European part of the USSR could also be expressed by iso-correlations and regional regression equations. Local forecasts can be similarly obtained, with only this difference: that the lateral transfer of heat into a definite region of the North Atlantic and the beginning of the ice phase at a definite station of interest on a river will serve as the variables in statistical correlations.

In conclusion, it is necessary to emphasize that everything stated in this article pertains to a working hypothesis serving to direct future developments in methods for forecasting the freezing and thawing of rivers in the European part of USSR. The consulting assistance in the forming of a working hypothesis was afforded V.V. Shuleykin, who also looked over the manuscript of this article; in addition, V. I. Vize and V. V. Timenov took the trouble of reading this work. The author expresses his gratitude to the people stated.

[Note: Below is a brief abstract of an allied report appearing in the same  
trudy', pages 95-135.]

AN EXPERIMENTAL STUDY ON THE INTENSITY OF SNOW  
MELTING IN THE FORMATION OF SPRING FLOODS

pp. 95-134

O. A. Spengler

Observations on snow run-off during one season certainly could not give enough of a decisive answer to a series of questions concerning the formation of spring floods. Therefore, it is necessary to consider the 1938 work on the Valdai Mountains as merely the first experiment in the study of elementary run-off on a natural watershed. But it seems to us that the results of observations possess some interest, although in appraising their value one must not forget that they were obtained under the specific conditions of the long spring of 1938 and could be contrary to data obtained under different weather conditions. One of the principal results of the 1938 observations is the fact that the run-off conditions in the various parts of such a small watershed at Usadieoskiy are different. Evidently, one must observe each natural basin individually.

- E N D -